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Patterns in textured dust storms in Mars North Pole

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We report on the cloud top morphology, scale-analysis of patterns, and dynamics of ‘‘textured” local dust storms on Mars observed at the edge of the North Polar cap during the Northern Hemisphere Spring Equinox, before aphelion, using images obtained by the Visual Monitoring Camera (VMC) [1] and High Resolution Stereo Camera (HRSC) [2] onboard Mars Express. VMC images were analyzed with tools described in previous works [3-4] and HRSC images were analyzed from map-projections.

The observations cover the period from March 3 to July 17, 2019, corresponding to the solar longitude range Ls = 350° - 55° (Martian Years 34 to 35). We observed the continuous formation of circumpolar dust patches, large frontal arc-shaped features, flushing dust storms, textured local dust storms and other forms of cloud activity at the edge of and inside the North Polar cap around latitude 60°N, a rich phenomenology typical of this season [5]. In this presentation we concentrate on the study of three textured local dust storms observed at the end of May and early June 2019.

The observed textured storms contained cellular structure and frontal-like banding, both indicative of organized active lifting within the storm [6-7]. The first storm was centered at about 185°E, 60°N and occupied a small area of 1.75×10^5 km^2. It showed three frontal bands with lengths ~ 1000 km and widths of 85 km separated by 40 km. In the interior of the storm a cellular pattern developed with a mean size of 50 km x 20 km. The second storm was centered at about 330°E, 60°N, occupied an area of 1.3×10^6 km^2 and moved zonally with velocities from 20 to 45 ms^{-1}. A global cellular pattern covered this storm with cells of a mean size of 135 km x 60 km and inter-cell distances in the range 100-300 km. The third storm was centered at about 150°E, 65°N, occupied an area of $1.6\text{-}2.1 \times 10^5$ km^2 and moved zonally with a mean velocity of 38 ms^{-1}. Its cellular pattern had a mean size of 70 km x 40 km. In all cases, the cell texture is anisotropic in the horizontal size (length/width, l/w~ 2) and their value is well above the atmospheric scale height (H ~ 8 km). Deep convection driven by buoyancy generated by the radiative heating of atmospheric dust is proposed to explain this structure.

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